ENV ROLD

AMBIENT AIR QUALITY IN WINDSOR AND VICINITY

Annual Report 1980

Ministry of the Environment
Ontario

164

AMBIENT AIR QUALITY
IN
WINDSOR AND VICINITY

Annual Report 1980

Technical Support Section
Southwestern Region

ONTARIO MINISTRY OF THE ENVIRONMENT
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TABLE OF CONTENTS

Table of Contents - continued

Table of Contents - continued

SUMMARY

Air quality monitoring conducted by the Ministry of the Environment revealed continued improvement in the air quality of Windsor and vicinity. Levels of sulphur dioxide, carbon monoxide, nitrogen dioxide and heavy metals compared favourably with Ontario's criteria for desirable ambient air quality. The Air Pollution Index did not exceed the acceptable range of 0 to 32.

During 1980 particulates, measured as dustfall and total suspended particulate matter, exceeded the criteria for desirable ambient air quality. Although excursions above the criteria occurred in most areas of Windsor and vicinity, the frequency of such excursions was generally lower than in previous years. The greatest improvement was noted at station 12013, located near the casting plant of Ford Motor Company of Canada, Limited. This improvement is attributable to reduced emissions as a result of additional pollution control equipment installed at the plant and its closure during September, 1980.

Fluorides were also lower in 1980 than in previous years. No discernible damage to vegetation attributable to fluorides was detected in Windsor during 1980. Consequently, the occurrence of occasional excursions above the criteria for desirable ambient air quality, which for fluorides are based on vegetation damage, does not appear to be a serious concern.

During the spring and summer of 1980, levels of ozone in Windsor and the rest of southwestern Ontario continued to exceed the criterion for desirable ambient air quality. Damage to vegetation attributable to ozone was again noted in 1980. The elevated levels of ozone partly result from local emissions and, to a greater degree, from

the long-range transport into southern Ontario of ozone and pollutants that react to form ozone. A co-operative study to develop an ozone control strategy for southeastern Michigan is scheduled for 1981. Participants in this study include the Southeast Michigan Council of Governments, control agencies for Michigan and Wayne County, private industry, the University of Michigan and this Ministry. Windsor and other areas of Ontario downwind of the southern Michigan area should benefit from the implementation of such a control strategy.

INTRODUCTION

The Ontario Ministry of the Environment operates a network of ambient air monitors in the Windsor area to measure levels of a number of pollutants that may adversely affect health, vegetation or the enjoyment of property. Data on the levels of pollutants are compared with Ontario's criteria for desirable ambient air quality. Data are also used to determine trends in air quality and therefore the effectiveness of pollution abatement. As well, information is provided on the effects of specific sources of pollutants and for use in the formulation of strategies to control emission sources. The air quality monitoring program is complemented by the Ministry's phytotoxicology surveys which determine effects of air pollutants on vegetation.

In accordance with the Memorandum of Understanding on Transboundary Air Pollution Control in Southwestern Ontario - Southeastern Michigan signed in 1974 by Governor Milliken and Premier Davis there is a regular exchange of both air quality data and reports on progress of compliance with abatement schedules. The information exchanged is used by the International Joint Commission, the International Michigan - Ontario Air Pollution Board and the Michigan-Ontario Transboundary Air Pollution Committee to prepare annual reports on air quality and pollution abatement programs.

This annual report deals more specifically and extensively with ambient air quality in the Windsor area than do the international reports.

DESCRIPTION OF MONITORING NETWORK

The Ministry operates continuous and intermittent

ambient air monitors at fixed sites throughout the Windsor area. Ideally, monitoring is conducted at the same sites year after year in order to provide a historical trend of air quality. However, many stations have had to be relocated or terminated because of local interferences or changing land-use patterns. Nevertheless, the number of existing historical stations are deemed adequate to evaluate the long-term trend in levels of pollutants.

Monitoring sites are distributed more densely in the downtown area where emissions from motor vehicles and commercial establishments are most prevalent and in west Windsor, which is close to a heavily industrialized portion of Wayne County, Michigan. The locations of the Ministry's monitoring stations in the Windsor area are illustrated in Appendix 1, Figure 1 and are described in Table 1 of the same Appendix.

Also shown in Figure 1 are the locations of 5 monitoring sites at which Ontario Hydro operates sulphur dioxide monitors. The sulphur dioxide monitors of Ontario Hydro are located in different directions from the J. C. Keith Generating Station at distances ranging from 5 to 7 kilometres.

The pollutants monitored at the various Ministry stations are shown in Appendix 1, Table 2. Ontario's criteria for desirable ambient air quality with respect to these pollutants and the prime factors supporting these criteria are contained in Appendix 1, Table 3.

METEOROLOGICAL DATA

Meteorological data have been obtained over the years at the Ministry's stations 12032 and 12034. At station

12032, located in the Morton Dock area of west Windsor, wind speed and direction have been measured at levels 7 metres and 30 metres above ground. However, severe winds in July 1980 destroyed most of the meteorological tower. In addition, considerable data were lost during the early part of the year when entry to the station to make repairs to a faulty instrument was prevented by a strike at the Morton Terminal.

At station 12034, located close to downtown Windsor and the Detroit River, data have been collected for wind speed and direction at the 10-metre and 46-metre levels. Ambient temperature at the 10-metre level and the difference in ambient temperatures between the two levels are measured, also. However, a tall building has been erected close to station 12034 and wind speed and direction measurements are distorted.

In the absence of reliable meteorological data from either station 12032 or 12034 the Ministry requested and received access to data from the meteorological tower of Ontario Hydro. Arrangements were made for wind speed and wind direction information from levels 18 metres and 80 metres above ground level to be telemetered from the Ontario Hydro tower to the Ministry computer in Toronto. Ambient temperature at the 18-metre level and temperature differences between the 18- and 80-metre levels will be obtained. Data will be available starting January 1981. The Ministry has assigned station number 12001 to this meteorological monitoring site.

Normally the meteorological data collected are correlated with other pollutants such as suspended particulates, sulphur dioxide and ozone to determine sources of pollutants. However, with the absence of valid meteorological data for much of 1980 the correlations could not be determined for this year. Meteorological data are also used to forecast dispersion conditions in association with the Air Pollution Index.

PARTICULATES

The iron and steel industry, foundries, power generating plants utilizing fossil fuels and road traffic are primary sources of particulates that adversely affect air quality in Windsor. Wind-blown particles from open fields, sand and coal piles, roadways and roofs are also significant sources.

Measurements for particulates are reported as suspended particulates, dustfall and soiling index. Levels of suspended particulates are determined by drawing measured volumes of air through a filter for 24 hours and subsequently weighing the quantity of particulates collected on the filter. Dustfall is measured by exposing an open cylinder (jar) of known diameter for 30 days and subsequently weighing the amount of particulates collected in the jar.

Soiling index is determined by measuring the difference in the amount of light transmitted through a filter before and after ambient air is drawn through the filter for periods of 1 or 2 hours. The amount of light transmitted through the filter is affected by the quantity, size, shape and opaqueness of particulates retained on the filter. Light transmitted through the filter is measured by a photoelectric cell and the soiling index may be calculated immediately. This immediate availability of the soiling index in contrast to the time-consuming laboratory analysis required for total suspended particulates has resulted in the soiling index being used in the Air Pollution Index as an indicator of levels of suspended particulates.

SUSPENDED PARTICULATES

Two criteria for desirable ambient air quality exist for total suspended particulate matter. One is 120 micrograms of suspended particulates per cubic metre of air (ug/m^3) averaged over a 24-hour period. The other is an annual geometric mean of 60 ug/m^3. The criterion for 24 hours is based on impairment of visibility and adverse health effects associated with combined concentrations of sulphur dioxide and suspended particulates. The annual criterion is based on public awareness of suspended particulates and property damage.

During 1980 filters were exposed to collect suspended particulate matter at 13 sites in the Windsor area on a sampling frequency of every sixth day. Levels of suspended particulates continued to be excessive in parts of the Windsor area during 1980. The annual criterion for desirable ambient air quality was exceeded at 9 of the 13 monitoring sites while the 24-hour criterion was exceeded at 12 of the 13 monitoring sites. However, there are some positive aspects to the levels of suspended particulate matter. Meeting the annual criterion at 4 sites during 1980 compares favourably to the best previous record of meeting this criterion at 2 sites. Also, meeting the 24-hour criterion at one site (station 12010) was accomplished for the first time during 1979 and was repeated in 1980. A summary of data for 1972 to 1980 is presented in Appendix 2, Table 4.

Figure 2 of Appendix 2 illustrates the annual geometric mean concentrations and the percent frequencies of excursions above the 24-hour criterion at the approximate locations of the monitoring stations. Higher annual geometric means and higher frequencies of excursions above the 24-hour criterion occur in west Windsor which is immediately downwind of the prevailing winds from a heavily industrial-

ized area of Wayne County, Michigan. Although levels of particulates in the downtown area were above the annual criterion and exceeded the 24-hour criterion more frequently than the residential areas of east Windsor, the 1980 levels were generally lower than previously reported for downtown Windsor.

During 1980 levels of particulates demonstrated an appreciable improvement at station 12013, located near the casting plant of Ford Motor Company of Canada, Limited. The annual geometric mean, which averaged 102 ug/m^3 over the previous 4 years, was 75 ug/m^3 in 1980 and the frequency of excursions above the 24-hour criterion, which averaged 40 percent during the previous 4 years, was reduced to 15 percent in 1980. The improvement in air quality at this site must be attributed largely to reduced emissions from the casting plant as a result of improved particulate control facilities and restricted production.

A comparison of the averages of the annual geometric means and the frequencies of excursions above the 24-hour criterion for eight monitoring stations that have been in operation since 1972, appears in Figure 3, Appendix 2. An improvement in levels of particulates is evident from 1972 to 1975 but no appreciable change is evident from 1975 to 1980. The levels reported for 1975 and 1980 were the lowest for the nine-year period.

Chemical Analysis of Suspended Particulates

As part of a Province-wide study, samples of suspended particulates collected at various stations in Windsor were analyzed quantitatively for cadmium, chromium, copper, iron, lead, manganese, nickel, nitrate, sulphate and vanadium. A summary of data collected from 1976 through 1980 appears in Appendix 2, Table 5.

Criteria for desirable ambient air quality exist for cadmium, lead, nickel and vanadium. Concentrations of these metals have been low with no values above the criteria. In general, the levels of metals in suspended particulates were lower or equal to the levels reported for previous years. There is no readily apparent trend of changing levels of nitrate or sulphate.

With the exception of the maximum value reported for station 12039, the average and maximum levels of iron reported for the various stations in Windsor were lower for 1980 than for previous years. On two occasions in 1980 when particulate samples were collected, iron levels at station 12039 were elevated - 23.3 and 37.0 ug/m³. Based on the limited information available on wind direction, these elevated iron levels were probably caused primarily by emissions from the scrap metal recycling operation of Zalev Bros. Ltd. The greatest reduction in the average and maximum levels of iron occurred at station 12013 and may be attributed to reduced emissions from the casting plant of Ford Motor Company of Canada, Limited which added additional control facilities and was on reduced production or shutdown for part of 1980.

Much of the decrease in lead levels may be attributed to decreases in lead emissions from motor vehicles.

DUSTFALL

The criteria for desirable ambient air quality established for dustfall are a 30-day loading of 7.0 grams of dustfall per square metre ($g/m^2/30$ days) and an annual average of 4.6 $g/m^2/30$ days. These criteria were established on the basis of historical data and standards developed by other enforcement agencies.

In general, dustfall levels were lower in 1980 than in previous years. Notwithstanding this improvement the annual criterion was exceeded at 11 of the 21 sites where dustfall is measured. Excursions above the 30-day criterion were measured at 15 of the 21 monitoring sites. The 1980 dustfall values appear in Table 7, Appendix 2. Figure 4 depicts the annual averages for dustfall and the frequencies of excursions above the 30-day criterion as determined for the different monitoring stations during 1980. It is evident that higher levels of dustfall and more frequent excursions occur in west Windsor and the industrialized area of east Windsor near Walker Road and Wyandotte St. E. than in the residential areas.

The trend towards lower levels of dustfall is illustrated by Figure 5, Appendix 2. This table shows a decrease in the arithmetic mean of annual averages for 14 monitoring sites that operated from 1972 through 1980. A decrease in the arithmetic mean for the frequencies of excursions above the 30-day criterion is evident.

SULPHUR OXIDES

Combustion of sulphur-containing fuels comprises the predominant source of man-made emissions of sulphur oxides. Thus, primary emitters of sulphur oxides are power plants and industries utilizing fossil fuels to meet requirements for large amounts of energy.

During 1980 sulphur oxides were measured in Windsor as gaseous sulphur dioxide and as sulphate in suspended particulate matter. Continuous measurements of gaseous sulphur dioxide were made primarily by analyzers utilizing fluorescence technology. Data for sulphate in suspended particulates are presented in the summary table (Table 5, Appendix 2) supporting the section on the Chemical Analysis of Suspended Particulates.

SULPHUR DIOXIDE

The criteria for desirable ambient air quality with respect to sulphur dioxide are 0.25 parts of sulphur dioxide per million parts of air (ppm) averaged for 1 hour, 0.10 ppm averaged for 24 hours (midnight to midnight) and 0.02 ppm as an annual average. The 1-hour and annual criteria were established for the protection of vegetation while the 24-hour criterion serves to protect human health.

During 1980 gaseous sulphur dioxide was measured continuously by the Ministry of the Environment at four fixed locations in west, east and downtown Windsor. The criteria for desirable ambient air quality pertaining to sulphur dioxide were met at all monitoring sites for the third consecutive year. A fifth monitor which operated from 1974 through 1979 at station 12015 (site of the West Windsor Water Pollution Control Plant) was taken out of service. Monitoring for sulphur dioxide at station 12015 was initiated to evaluate the impact of emissions from the J. C. Keith Generating Station of Ontario Hydro, as well as emissions from sources in the Zug Island area of Michigan. However, because power generation at this plant has been terminated indefinitely, other monitors exist in close proximity, and since in recent years there has been an absence of elevated levels of sulphur dioxide in the Windsor area, it was decided that the manpower required to maintain the monitor could be better utilized elsewhere.

Although the data are not contained in this report, the criteria for desirable ambient air quality were also met during 1980 at the 5 monitoring sites maintained by Ontario Hydro in the Windsor area.

A summary of 1980 Ministry data for sulphur dioxide is presented in Table 7, Appendix 3. Figure 6 displays the

trend of decreasing levels of sulphur dioxide reported for stations 12008 and 12032 since 1972. The improvements in levels of sulphur dioxide are attributable to better control and dispersion of emissions of sulphur dioxide in Wayne County, Michigan and Windsor.

AIR POLLUTION INDEX

The Air Pollution Index (API) is a system designed to control or prevent an air pollution episode. Meteorological forecasting and readings of sulphur dioxide and suspended particulates are utilized to predict the potential for the persistence of deteriorating air quality conditions that are numerically reported as the API.

Data for suspended particulates are provided by the measurement of soiling index and a correlation between concentrations of suspended particulates and soiling index. Hourly values of soiling index and gaseous sulphur dioxide, are used to compute 24-hour running averages which are inserted into the following equation:

$$API = 7.89\ (18.26\ COH + 156.7\ SO_2)^{1.06}$$

where: COH is the 24-hour average for soiling index expressed in co-efficient of haze units.

SO_2 is the 24-hour average concentration of sulphur dioxide expressed in parts per million.

API values up to 32 are considered acceptable. Values from 32 to 49 are at the Advisory Level and if adverse weather conditions are likely to persist, contributors of major emissions are advised to prepare to curtail operations. At an API of 50 major emitters may be ordered to curtail

operations. At 75, further cutbacks can be required. When the API reaches 100 all industries and other contributors of pollution not essential to public health and safety can be ordered to cease operation.

Levels of soiling index and sulphur dioxide utilized for the computation of two separate API's are obtained at station 12008, in downtown Windsor, and at station 12016 in west Windsor. For the second consecutive year the API did not exceed the acceptable range at either station. Each station reported a maximum API of 25 during 1980.

CARBON MONOXIDE

Combustion processes account for man's major emissions of carbon monoxide. Emissions from motor vehicles are especially significant because they occur near ground level and are concentrated in urban areas where the public may be exposed for long periods. Major industries and power generating plants normally provide adequate dispersion for their emissions to prevent unsatisfactory levels of carbon monoxide in ambient air.

The criteria for carbon monoxide are 30 ppm averaged for 1 hour and 13 ppm averaged for any consecutive 8-hour period. These criteria were established for the protection of human health and have not been exceeded in the past 5 years, based on monitoring at station 12008. Since this station is located in the downtown area of Windsor where the highest levels of carbon monoxide are anticipated, there is a high probability that levels are acceptable throughout the Windsor area.

A summary of data for carbon monoxide, obtained since 1972, is presented in Appendix 4, Table 8. Data

obtained from 1972 to 1976 are higher than data for the past four years. The differences in levels are attributed in part to replacement of a less accurate monitoring unit with a more sophisticated monitor (infra-red principle) late in 1976.

OXIDES OF NITROGEN

Like many other pollutants, oxides of nitrogen are emitted into the atmosphere by man through combustion processes. Nitric oxide and nitrogen dioxide are the compounds of primary interest.

Criteria for desirable ambient air quality exist for nitrogen dioxide, but not for nitric oxide or total oxides of nitrogen. The criteria, which are based on the protection of human health and offensive odours, are 0.02 ppm averaged for 1 hour and 0.10 ppm averaged for 24 hours (midnight to midnight).

During 1980 the criteria were not exceeded and in general 1980 levels of nitrogen dioxide and nitric oxide were comparable to those of 1979. Nitric oxide levels in 1979 and 1980 were lower than in previous years. The data were determined by a continuous monitor (chemiluminescent principle) located at station 12008 in downtown Windsor where emissions from motor vehicles would be concentrated. A summary of data for oxides of nitrogen is presented in Table 8, Appendix 4.

Although criteria for nitrogen dioxide were not exceeded during 1980 (in fact there has only been one excursion above the 1-hour criterion since monitoring began in 1973), oxides of nitrogen contribute to the formation of unsatisfactory levels of air pollution through their role

in the formation of photochemical oxidants. Also, oxides of nitrogen contribute to the formation of acid precipitation which has been identified as a very serious problem in parts of Ontario. Consequently, consideration is being given to tightening controls on oxides of nitrogen.

HYDROCARBONS

The principle man-made source of hydrocarbons is emissions from motor vehicles. Other significant man-made sources are incomplete combustion of fuels by industries and power plants and evaporation losses during the storage and transportation of hydrocarbons. Natural phenomena produce many hydrocarbons of which methane is the most abundant.

Owing to the wide range of effects associated with different hydrocarbons at various concentrations, no criteria for desirable ambient air quality have been established for total hydrocarbons. Instead, control is achieved by setting criteria for desirable levels of specific hydrocarbons in ambient air and/or establishing standards which control the impact of emissions of specific hydrocarbons.

Although there are no criteria for total hydrocarbons, monitoring for them provides information on trends in levels of hydrocarbons. Increasing levels of hydrocarbons could be significant should they be attributable to detrimental compounds. Furthermore, the non-methane hydrocarbons or "reactive" hydrocarbons may partake in photochemical reactions which produce excessive levels of oxidants.

Total hydrocarbons are monitored continuously at station 12008 in downtown Windsor, using flame ionization detection. Monitoring of non-methane hydrocarbons was started in November, 1980 at the same site. Levels of total

hydrocarbons in 1980 were similar to levels of previous years and no trend of increasing or decreasing levels is apparent. A summary of annual average concentrations appears in Table 8, Appendix 4. For November and December, 1980, the two months when non-methane hydrocarbon measurements were obtained, the non-methane hydrocarbons accounted for approximately 20 percent of the average total hydrocarbon concentration.

OXIDANTS

A major portion of the oxidants in the ambient air are a result of photochemical reactions and inter-reactions involving oxides of nitrogen and hydrocarbons. The reactions are promoted by certain meteorological conditions such as warm temperatures and intense sunshine which cause higher levels of oxidants in the spring and summer months.

Ozone normally accounts for 80 to 90 percent of the photochemical oxidants in ambient air and the monitoring technology for ozone is more accurate and efficient than that for total oxidants. For these reasons most regulatory agencies, including this Ministry, monitor for ozone rather than total oxidants.

Ozone, is also present in the stratosphere where it plays the critical role of absorbing excessive amounts of ultraviolet solar radiation that may be biologically harmful. Occasionally, ozone from the stratosphere may be transported downwards to cause elevated concentrations at the earth's surface. Ozone is naturally produced in minor amounts by lightning.

Long-range transport of ozone and its precursor chemicals (oxides of nitrogen and hydrocarbons) can account for a very significant portion of local levels of ozone.

Long-range transport from distances greater than 200 kilometres has been reported in the literature. Consequently, successful control of oxidants will depend on control strategies implemented in the United States as well as in Ontario.

The Environmental Protection Agency in the United States has established a primary standard for ozone of 120 parts per billion (ppb) averaged over a 1-hour period. Areas exceeding this standard will be required to develop a State Implementation Plan (SIP) by 1982. The SIP is to outline the actions to be taken to bring ozone levels into compliance with the standard. During 1980, Ontario is participating in a study with various groups in Michigan which will provide information pertinent to an ozone SIP for southeastern Michigan.

The Ontario criterion for desirable ambient air quality established for ozone is 80 ppb averaged for 1 hour. This criterion was established for the protection of vegetation, property and human health. Some effects detrimental to health that are associated with oxidants are eye irritation and a decrease in performance during physical activities.

Ozone is monitored by the chemiluminescent principle at station 12008, in downtown Windsor. During 1980, there were 149 hourly values reported in excess of the 1-hour criterion, all of which occurred during the months of April through August. The formation of ozone photochemically as well as the transportation of ozone from the stratosphere to the earth's surface are dependent on meteorological conditions and therefore, there are fluctuations from year to year in the frequencies of excursions above the criterion. A summary of ozone data is presented in Appendix 4, Table 8, which indicates that the frequencies of excursions during 1980 were greater than those of 1974 and 1979, but slightly less than those of 1975 through 1978.

FLUORIDES

Sources of fluorides in the Windsor area are the steel industry located in the downriver area of Wayne County, Michigan, power plants where the coal burned contains trace amounts of fluorides, fluorspar unloading operations at docks in west Windsor and subsequent trucking of fluorspar to a location south of Windsor.

Fluoridation rate is a measurement designed to indicate the relative amount of gaseous fluoride present over an extended period of time. A lime-impregnated filter is exposed to ambient air for thirty days and then analyzed for fluoride content. This monitoring technique measures primarily gaseous fluoride but some fluorides in particilate form may be collected on the filter.

The criteria for desirable ambient air quality established for fluoridation rate are based on the protection of vegetation. Consequently, a criterion of 40 micrograms of fluorides per 100 square centimetres of filter per 30 days (ug F/100 cm^2/30 days) has been established for the growing season from April 15 to October 15 while a criterion of 80 ug F/100 cm^2/30 days applies to the period October 16 to April 14. Since the months of April and October are common to both criteria and fluoridation rate is measured on a monthly basis, excursions during these months are determined by comparing the fluoridation rate to the average of the two criteria (60 ug F/100 cm^2/30 days).

During 1980 there were eight sites where fluoridation rates were monitored, 5 in west Windsor and 3 in the downtown area. Data for the first part of 1980 could not be obtained for station 12032 because access to the site was restricted by a strike at the Morton Dock terminal. Data

for the month of September was lost for all stations because of problems in the Ministry laboratory.

Figure 7, Appendix 5 shows that during 1980 higher annual averages for fluoridation rates occurred in west Windsor than in downtown Windsor. The criteria for fluoridation rate were exceeded in west Windsor but not at the downtown sites. The 1980 fluoridation rates appear in Table 9, Appendix 5.

Fluoridation rate is not considered a sensitive indicator of temporal trends of fluorides. However, it should be noted that based on data from six monitoring sites in operation since 1972, the annual averages for fluoridation rate and the frequency of excursions above the criteria have exhibited a steady decrease in recent years with values for 1980 being the lowest. Figure 8, Appendix 5 depicts the trend in fluoridation rates.

APPENDIX 1

DESCRIPTION OF MONITORING NETWORK

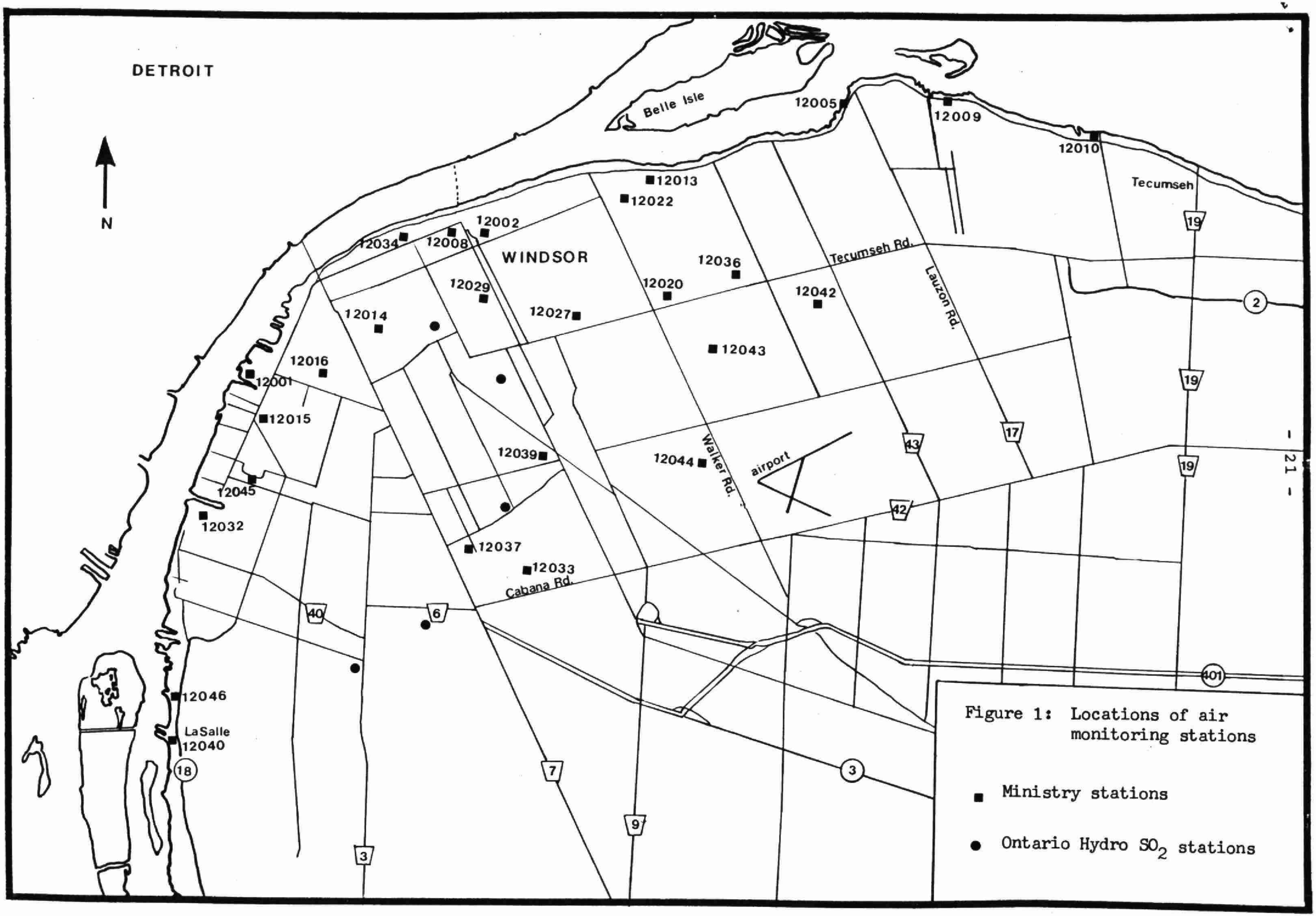


Figure 1: Locations of air monitoring stations

■ Ministry stations

● Ontario Hydro SO_2 stations

Table 1. Locations of air monitoring stations

Station number	Location	Universal transverse mercator projection co-ordinates	Elevation above sea level (metres)	Air intake height (metres)
12001	1.1 km NNE of J. C. Keith Generating Station	03276 - 46839	180	18 & 80
12002	444 Windsor Avenue, City Hall	03323 - 46867	183	17
12005	7730 Riverside Drive East	03395 - 46890	177	10
12008	467 University Avenue	03316 - 46867	183	12
12009	Tecumseh Water Works	03413 - 46888	180	2
12010	Tecumseh Sewage Pumping Station	03460 - 46875	181	1
12013	3665 Wyandotte Street East	03358 - 46874	185	7 & 10
12014	College/California Street	03304 - 46849	185	1
12015	Highway No. 18/Prospect	03283 - 46833	175	6
12016	College/South Street	03290 - 46841	175	4
12020	1869 Albert Street	03363 - 46854	183	5
12022	Hickory/Richmond Street	03352 - 46870	183	5
12027	1526 Parent Street	03340 - 46852	183	5
12029	459 Ellis West	03323 - 46853	185	5
12032	Morton Dock	03271 - 46817	175	4, 7 & 30
12033	3501 Longfellow	03335 - 46801	183	5
12034	C. P. Telecommunication Tower	03308 - 46868	175	10 & 46
12036	1794 Westcott Street at Milloy Street	03367 - 46858	186	5
12037	3225 California Street (St. Hubert's School)	03327 - 46816	183	4
12039	Dougall St./E. C. Row W	03337 - 46821	195	5
12040	225 Willow Drive (La Salle)	03261 - 46773	175	5
12042	Princess/Joinville Street	03384 - 46848	185	5
12043	Somme/Chandler	03366 - 46845	183	5
12044	Seymour/Turner	03366 - 46822	183	5
12045	Healy/Sandwich	03276 - 46822	183	5
12046	Adams/Hwy 18	03264 - 46778	175	5

Table 2. Parameters monitored in the ambient air in Windsor during 1980

Station Number	Air Pollution Index	Carbon Monoxide	Dustfall	Fluoridation Rate	Hydrocarbons	Meteorological Data	Nitric Oxide	Nitrogen Dioxide	Nitrogen Oxides	Ozone	Soiling Index (1-hr COH)	Sulphur Dioxide	Suspended Particulates
12001						X							
12002			X										X
12005			X										X
12008	X	X	X	X	X		X	X	X	X	X	X	X
12009			X										X
12010			X										X
12013			X									X	X
12014			X										X
12015			X	X								X	X
12016	X		X	X							X	X	X
12020			X										
12022			X	X									
12027			X	X									
12029			X										
12032			X	X		X						X	X
12033			X										
12034						X							
12036													X
12037													X
12039													X
12040			X	X									
12042			X										
12043			X										
12044			X										
12045			X	X									
12046			X										

Table 3. Desirable ambient air quality criteria established by the Ontario Ministry of the Environment

Parameter	Desirable ambient air quality criteria	Prime reasons for establishing criteria or monitoring parameter
Carbon monoxide	30 ppm averaged for 1 hour 13 ppm averaged for 8 hours	Protection of human health Protection of human health
Dustfall	7 grams/metre^2 in 30 days 4.6 grams/metre^2 (monthly average in 1 year)	Historial and in keeping with other control agencies
Fluoridation rate	40 ug of fluorides/100 cm^2 of limed filter paper in 30 days during April 15 to October 15	Protection of vegetation
	80 ug of fluorides/100 cm^2 of limed filter paper in 30 days during October 16 to April 14	Protection of vegetation (less restrictive criterion during the non-growing season)
Hydrocarbons (total)	None	Effects of hydrocarbons vary widely depending on their chemical-physical nature
Nitric oxide	None	Reacts with oxygen to produced NO_2
Nitrogen dioxide	0.20 ppm averaged for 1 hour	Protection of human health and protection against odours
	0.10 ppm averaged for 24 hours	Protection of human health and protection against odours
Oxides of nitrogen	None	

Table 3. continued

Parameter	Desirable ambient air quality criteria	Prime reasons for establishing criteria or monitoring parameter
Ozone	0.08 ppm averaged for 1 hour	Protection of vegetation and human health
Sulphur dioxide	0.25 ppm averaged for 1 hour	Protection of vegetation
	0.10 ppm averaged 1 day (24 hours)	Protection of human health
	0.02 ppm averaged for 1 year	Protection of vegetation
Suspended particulates	120 ug/m^3 averaged for 24 hours	Based on impairment of visibility and health effects
	60 ug/m^3 (geometric mean) during - year	Based on public awareness of visible pollution
Cadmium in suspended particulates	2.0 ug/m^3 averaged for 24 hours	Based on protection of human health
Lead in suspended particulates	5.0 ug/m^3 averaged for 24 hours	Based on protection of human health
	2.0 ug/m^3 as a geometric mean over a 30 day period	Based on protection of human health
Nickel in suspended particulates	2.0 ug/m^3 averaged for 24 hours	Based on protection of vegetation
Vanadium in suspended particulates	2.0 ug/m^3 averaged for 24 hours	Based on protection of human health

APPENDIX 2

PARTICULATES

Table 4. Summary of data for total suspended particulates.

Station	Year								
	1972	1973	1974	1975	1976	1977	1978	1979	1980
	Annual geometric means (ug/m³)								
12002	159	133	108	74	76	82	79	80	77
12005							I.D.	63	55
12008	126	126	116	82	80	87	80	80	71
12009	79	82	61	52	58	54	52	57	58
12010	85	86	58	46	54	47	46	53	47
12013	151	145	113	89	98	113	100	98	75
12014	152	148	139	95	94	96	77	103	92
12015	183	147	152	105	113	93	93	98	108
12016				88	88	95	84	85	83
12032	126	120	94	81	89	93	79	84	(88)
12036						72	63	72	70
12037						67	68	62	60
12039								79	71
	Percentage of values above 24-hour criterion								
12002	70	58	43	14	15	21	18	16	19
12005							4	4	2
12008	57	55	47	17	19	24	16	17	12
12009	16	25	10	2	5	7	9	4	9
12010	23	27	17	2	10	6	7	0	0
12013	65	69	44	26	37	40	40	42	15
12014	70	72	64	25	26	26	20	41	23
12015	80	66	84	33	42	25	27	33	46
12016				20	24	22	23	20	20
12032	53	53	30	21	27	25	19	16	(20)
12036						11	9	15	13
12037						10	15	2	2
12039								14	8

I.D. - Insufficient data to compute a representative geometric mean.

( ) - Annual geometric mean and percentage of values above 24-hour criterion based on data not representative of total year.

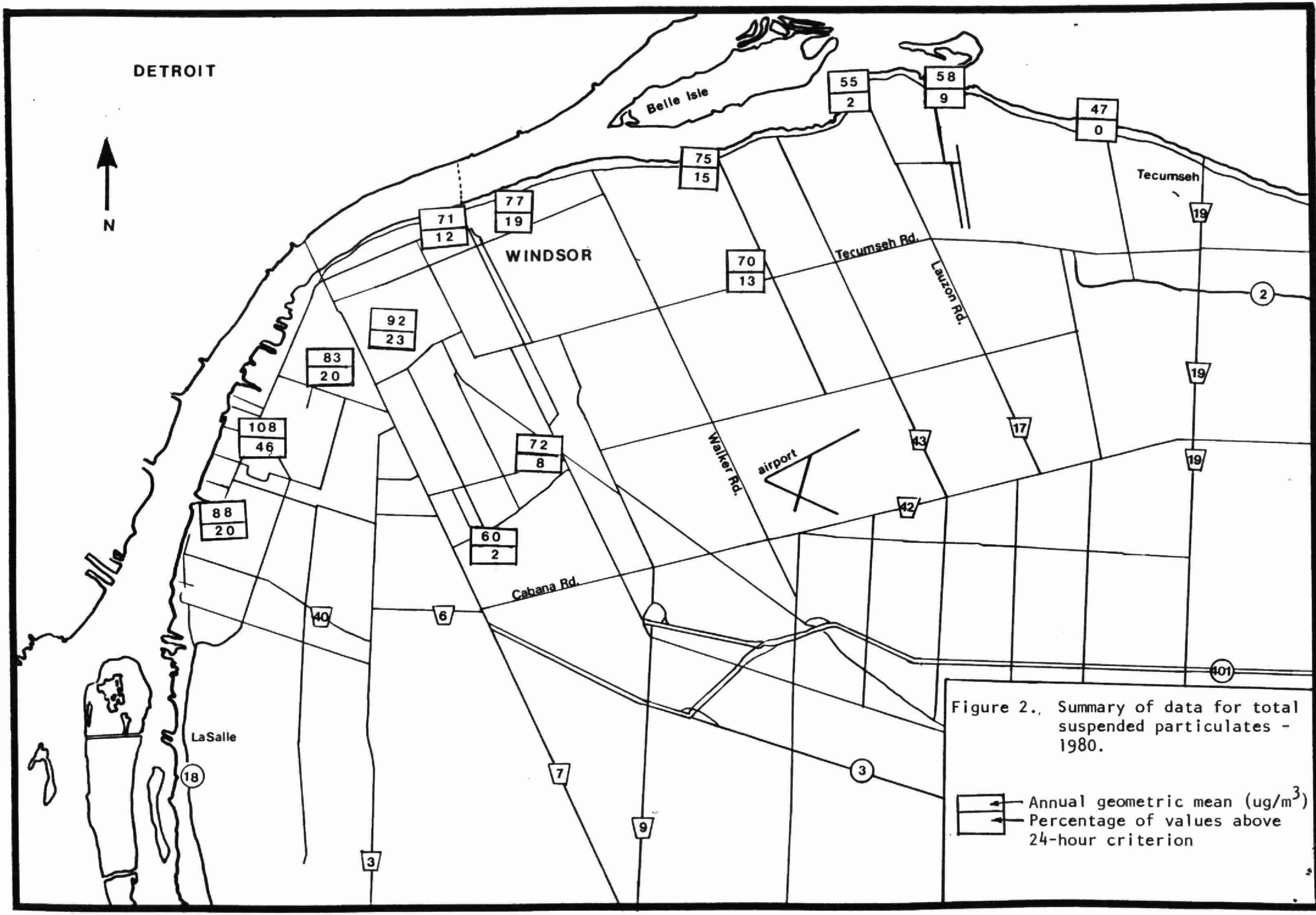


Figure 2., Summary of data for total suspended particulates - 1980.

Figure 3. Trend in levels of suspended particulates based on averaged data from eight monitoring stations.

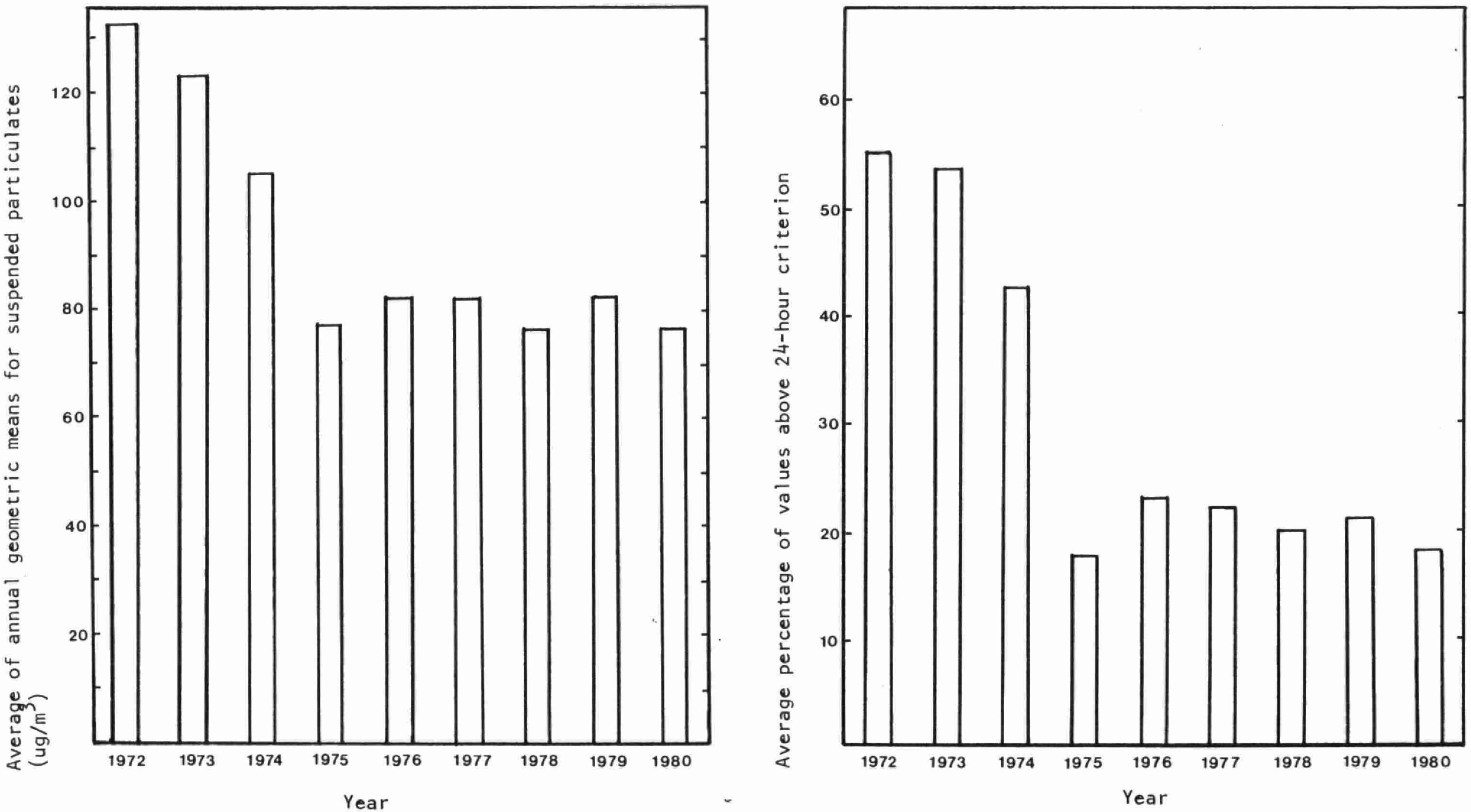


Table 5. Summary of constituents in suspended particulate matter (ug/m³)

Station and Year	Cadmium # of samples	Cadmium Avg.	Cadmium Max.	Chromium # of samples	Chromium Avg.	Chromium Max	Copper # of samples	Copper Avg.	Copper Max	Iron # of samples	Iron Avg.	Iron Max	Lead # of samples	Lead Avg.	Lead Max
12002															
1976	12	0.003	0.010	12	0.007	0.022	12	0.11	0.36	12	3.4	8.2	12	0.7	1.1
1977	20	0.006	0.016	20	0.032	0.062	20	0.16	0.52	20	3.1	8.4	20	0.7	1.3
1978	24	0.007	0.035	24	0.018	0.045	24	0.23	0.62	24	3.1	9.9	56	0.7	1.5
1979	28	0.004	0.020	28	0.009	0.026	28	0.08	0.20	27	2.0	5.9	49	0.5	1.0
1980	23	0.002	0.008	23	0.006	0.015	23	0.06	0.16	23	1.5	3.2	51	0.4	2.1
12008															
1976	15	0.001	0.003	15	0.012	0.029	15	0.26	0.45	15	3.3	6.9	15	0.7	1.3
1977	18	0.008	0.025	18	0.018	0.074	18	0.42	1.07	18	4.0	11.1	18	0.8	1.7
1978	23	0.004	0.019	23	0.017	0.045	23	1.13	2.55	23	3.1	9.0	23	0.6	1.8
1979	34	0.004	0.023	34	0.008	0.036	34	0.49	1.62	34	1.9	6.3	34	0.4	1.0
1980	24	0.002	0.008	24	0.004	0.012	24	0.38	1.18	25	1.7	4.1	51	0.4	1.1
12009															
1978													53	0.4	1.4
1979													47	0.2	0.8
1980													53	0.2	0.7
12010															
1976	12	0.001	0.006	12	0.008	0.026	12	0.12	0.52	12	1.6	5.2	12	0.4	1.0
1977	20	0.002	0.006	20	0.009	0.029	20	0.08	0.24	20	1.2	5.5	20	0.4	0.9
1978	24	0.002	0.007	24	0.007	0.020	24	0.13	0.44	24	1.0	2.5	24	0.3	1.2
1979	32	0.002	0.005	32	0.003	0.015	32	0.19	0.79	32	0.9	2.1	32	0.2	0.6
1980	23	0.002	0.006	23	0.003	0.007	23	0.09	0.21	24	0.5	1.7	23	0.2	0.7

Table 5. Summary of constituents in suspended particulate matter (ug/m³)

Station and Year	Manganese # of samples	Manganese Avg.	Manganese Max.	Nickel # of samples	Nickel Avg.	Nickel Max	Nitrate # of samples	Nitrate Avg.	Nitrate Max	Sulphate # of samples	Sulphate Avg.	Sulphate Max	Vanadium # of samples	Vanadium Avg.	Vanadium Max
12002															
1976	12	0.12	0.22	12	0.013	0.027	54	4.9	11.8	54	9.5	35.1	12	0.02	0.03
1977	20	0.11	0.32	20	0.025	0.073	56	4.9	21.6	56	12.5	35.5	20	0.04	0.14
1978	24	0.14	1.10	24	0.016	0.034	52	6.3	20.5	52	14.1	41.1	24	0.00	0.02
1979	28	0.08	0.20	28	0.009	0.015	49	6.8	17.8	49	13.4	28.4	28	0.00	0.03
1980	23	0.05	0.14	23	0.010	0.026	53	6.6	16.9	53	13.8	55.9	23	0.01	0.01
12008															
1976	15	0.11	0.28	15	0.051	0.409	105	4.8	21.6	104	10.7	39.7	15	0.17	1.47
1977	18	0.19	0.48	18	0.026	0.084	48	5.2	23.5	48	13.4	34.2	18	0.03	0.10
1978	23	0.12	0.31	23	0.026	0.059	55	5.3	20.5	55	14.3	57.1	23	0.00	0.03
1979	34	0.07	0.22	34	0.010	0.027	58	6.0	15.7	58	13.7	40.5	34	0.00	0.01
1980	24	0.06	0.15	24	0.014	0.049	52	5.5	16.2	52	11.8	31.0	24	0.01	0.01
12009															
1979							24	5.2	13.4	24	11.8	25.4			
1980							55	5.3	17.5	55	11.6	24.6			
12010															
1976	12	0.06	0.19	12	0.003	0.021	51	3.6	14.2	51	6.9	31.9	12	0.01	0.01
1977	20	0.04	0.20	20	0.019	0.035	52	4.4	24.5	52	10.3	25.4	20	0.01	0.02
1978	24	0.03	0.09	24	0.008	0.019	55	4.5	25.2	55	11.5	44.1	24	0.00	0.00
1979	32	0.03	0.07	32	0.005	0.011	54	5.1	12.6	54	11.5	30.3	32	0.00	0.02
1980	23	0.02	0.05	23	0.004	0.008	53	4.8	10.8	53	10.8	23.5	23	0.00	0.01
12013															
1976	17	0.38	1.94	17	0.004	0.029	59	4.5	15.0	59	8.3	21.0	17	0.01	0.02
1977	19	0.39	2.02	19	0.031	0.069	54	6.1	32.0	54	13.1	33.6	19	0.02	0.07
1978	23	0.24	0.95	23	0.013	0.058	56	6.6	22.8	56	14.7	48.4	23	0.00	0.03
1979	22	0.15	0.38	22	0.011	0.025	56	7.2	22.9	56	15.0	41.9	22	0.00	0.01
1980	11	0.11	0.47	11	0.007	0.012	54	6.0	19.4	54	13.0	26.9	11	0.01	0.01

Table 5. Summary of constituents in suspended particulate matter (ug/m³)

Station and Year	Cadmium # of samples	Cadmium Avg.	Cadmium Max.	Chromium # of samples	Chromium Avg.	Chromium Max	Copper # of samples	Copper Avg.	Copper Max	Iron # of samples	Iron Avg.	Iron Max	Lead # of samples	Lead Avg.	Lead Max
12013															
1976	17	0.006	0.035	17	0.028	0.113	17	0.15	0.28	22	5.8	21.9	17	0.8	2.0
1977	19	0.007	0.033	19	0.033	0.101	19	0.14	0.35	24	7.2	26.3	19	0.8	1.8
1978	23	0.003	0.012	23	0.032	0.116	23	0.09	0.26	57	6.6	23.1	23	0.5	1.0
1979	22	0.002	0.009	22	0.016	0.055	22	0.13	0.60	56	5.5	29.5	22	0.5	0.9
1980	11	0.001	0.002	11	0.009	0.025	11	0.12	0.37	49	2.6	7.7	11	0.3	0.7
12014															
1978										54	2.8	8.2			
1979										52	3.0	8.3			
1980										51	2.2	5.4			
12015															
1978										55	4.0	15.4			
1979										48	3.9	11.3			
1980										52	3.0	8.3			
12016															
1978										56	3.8	12.5			
1979										52	3.1	10.[illegible]			
1980										52	2.6	6.2			
12032															
1976										40	4.1	8.4	15	0.5	1.3
1977										29	3.5	17.9	26	0.5	0.9
1978										49	3.1	9.6	37	0.4	2.1
1979										43	3.6	9.6	58	0.3	1.4
1980										32	2.3	5.8	33	0.3	0.6
12039															
1978										33	6.3	55.8			
1979										56	3.4	24.6			
1980										54	3.1	37.0			

Table 6. Levels of dustfall during 1980

Station Number	Dustfall loading (g/m²/30 days) Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec	Annual Average	Percentage of values above monthly criterion
12002	5.8	5.1	4.1	4.9	5.7	3.9	4.3	2.5	4.9	3.8	3.4	3.1	4.3	0
12005	3.5	3.9	3.5	9.0		3.0	6.5	1.6		1.6	2.6	3.0	3.8	10
12008	5.9	5.3	4.6	4.3	7.6	6.7	5.2	3.7	5.6	4.7	4.1	3.5	5.1	8
12009	2.8	4.0		5.2	6.5		3.6	2.7	3.2	5.8	1.4	2.0	3.7	0
12010	2.3	2.3	2.9	2.6	5.4					2.0	3.5	1.5	(2.8)	0
12013	9.2	7.2	4.1	6.3	9.6	7.7	6.2	2.9	5.1	4.2	4.8	3.5	5.9	33
12014	7.6	7.3	5.9	8.8	14.4	12.3		4.5	8.6	5.3	5.0	5.6	7.7	55
12015	10.5	10.1	5.1	10.5	9.8	8.3	8.5	4.5	5.4	7.3	7.2	7.7	7.9	75
12016	4.8	4.5	3.0	4.9	6.8	5.4	5.9	2.9	5.4	3.5	3.0	3.0	4.4	0
12020	4.2	4.7	3.2	5.1	7.6	4.6	4.5	3.3	5.7	3.9	3.2	3.5	4.5	8
12022	9.3	9.4	9.3	12.4	12.8	12.5	10.8	5.8	12.1	7.3	5.8		9.8	82
12027	9.7	9.5	6.0	10.0	7.4	8.2	10.1	4.3	8.5	5.5	4.1	6.8	7.5	58
12029	5.4	5.0		4.9	8.4	5.5	7.5	3.6	8.1	4.5	4.0	6.1	5.7	27
12032						5.1	4.2	4.4	8.8	5.8	5.3	7.8	(5.9)	29
12033	4.5	5.5	5.2	4.8		3.2		2.9	5.5		3.0	5.8	4.6	0
12040	4.0	4.3	3.3	5.9	10.8	6.8	8.1	5.8	11.7	7.9	5.1	4.4	6.5	33
12042	3.0	3.6	3.8	3.6	4.1	7.7	4.7	3.7	4.8	3.6	2.2	3.4	4.0	8
12043	2.9	2.5	2.5	3.2	7.1	3.2	4.3	3.5	5.5	6.7	3.1	3.0	4.0	8
12044	3.6	3.7	4.1	4.6	7.5	5.6	6.8	3.0		4.0		2.9	4.6	10
12045	5.5	5.8	5.3	6.5	10.0	10.1		5.4	4.9	5.1	3.9	4.6	6.1	18
12046	4.9	6.5	7.5	13.3	8.4					5.2	5.2	4.7	7.0	38

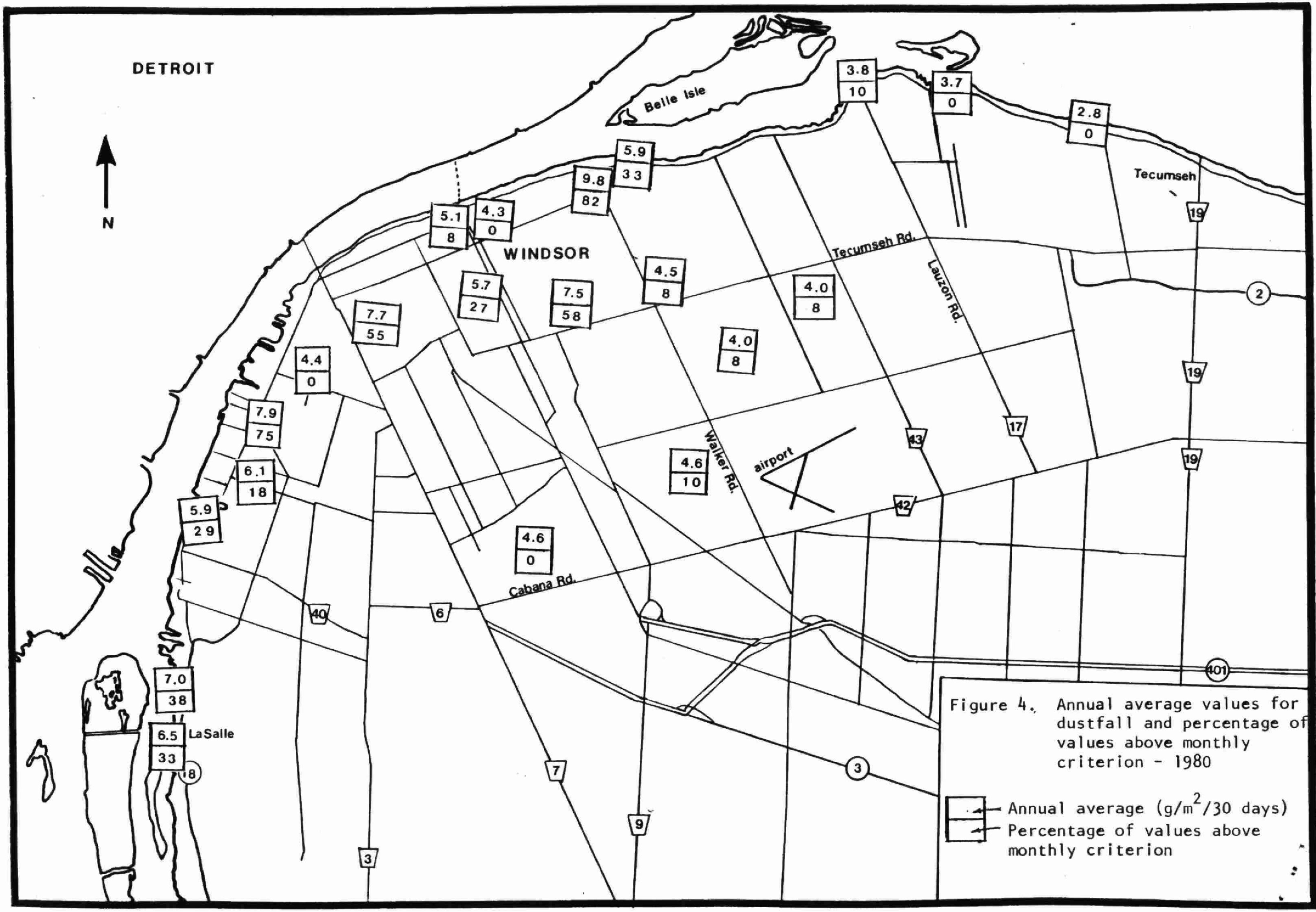
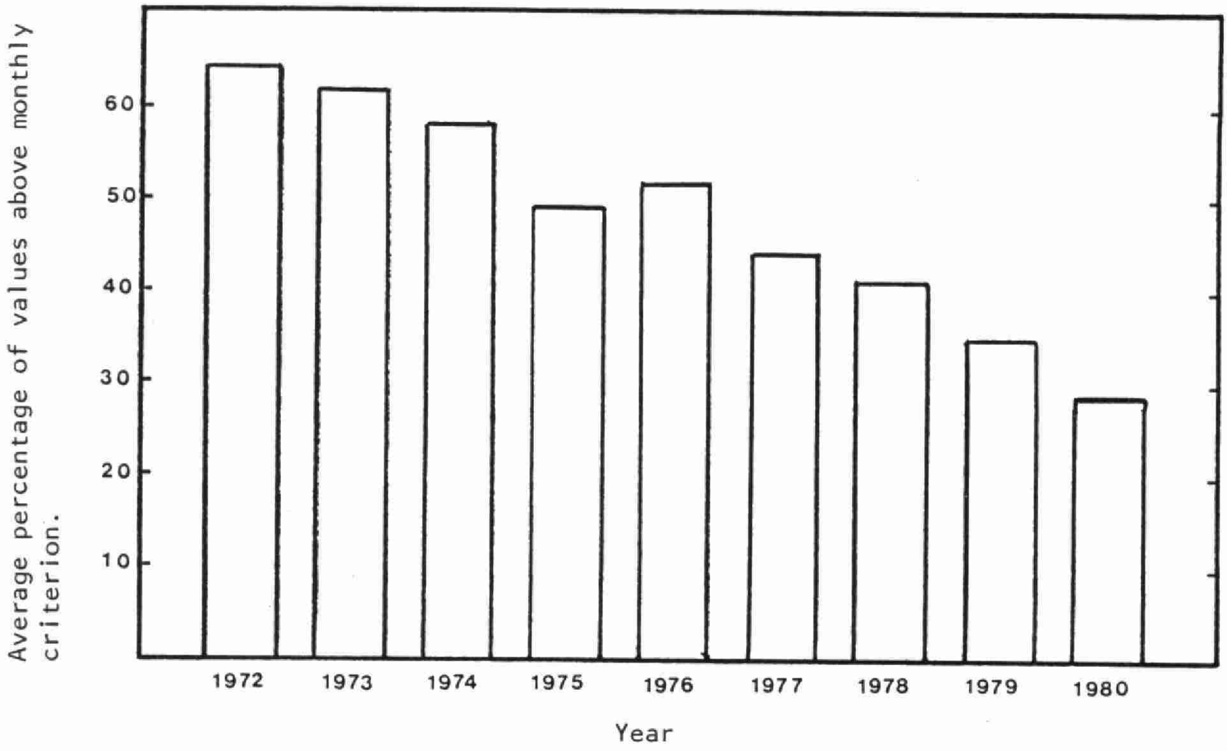
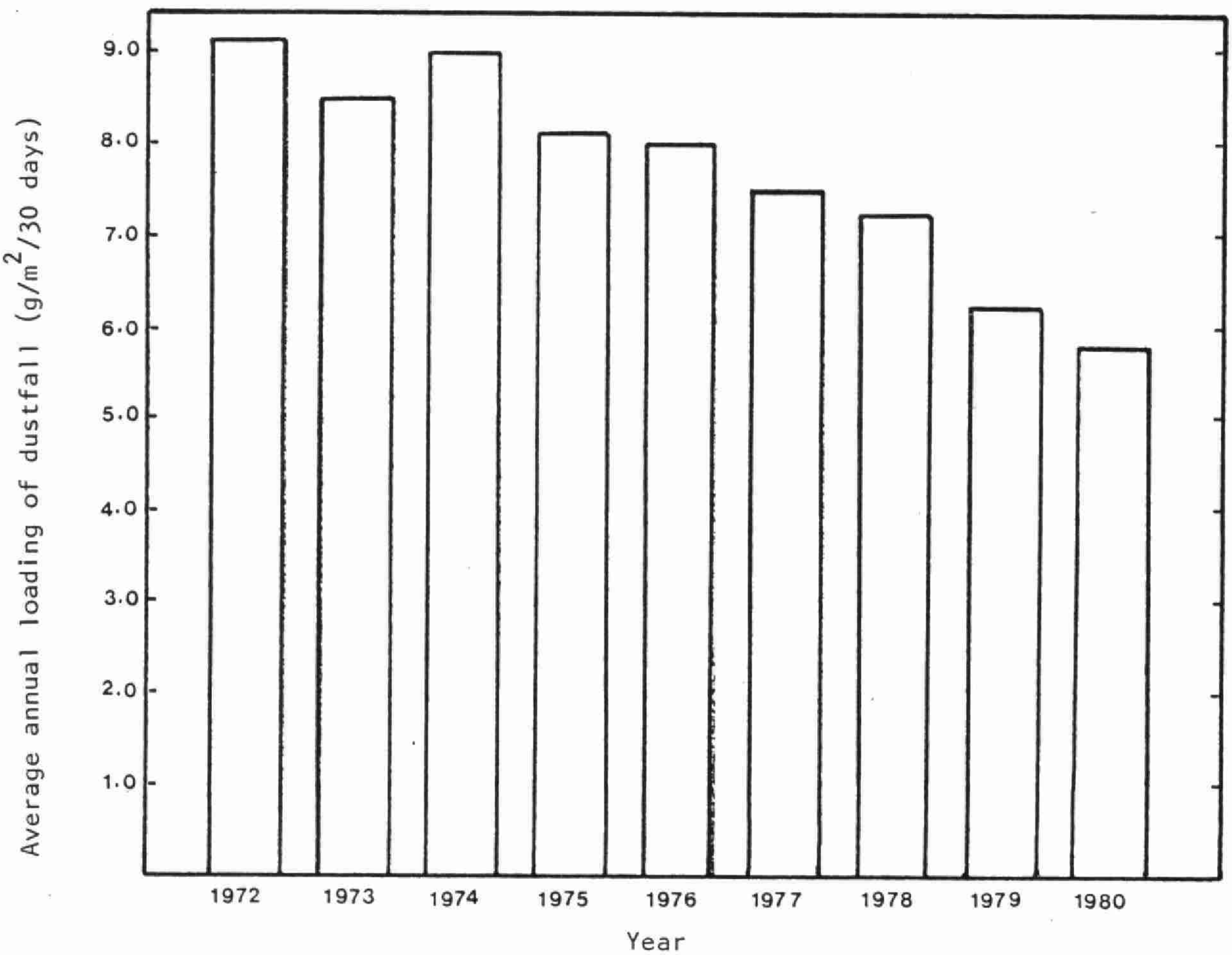


Figure 4. Annual average values for dustfall and percentage of values above monthly criterion - 1980

Figure 5. Trend in dustfall values based on averaged data for fourteen monitoring stations.





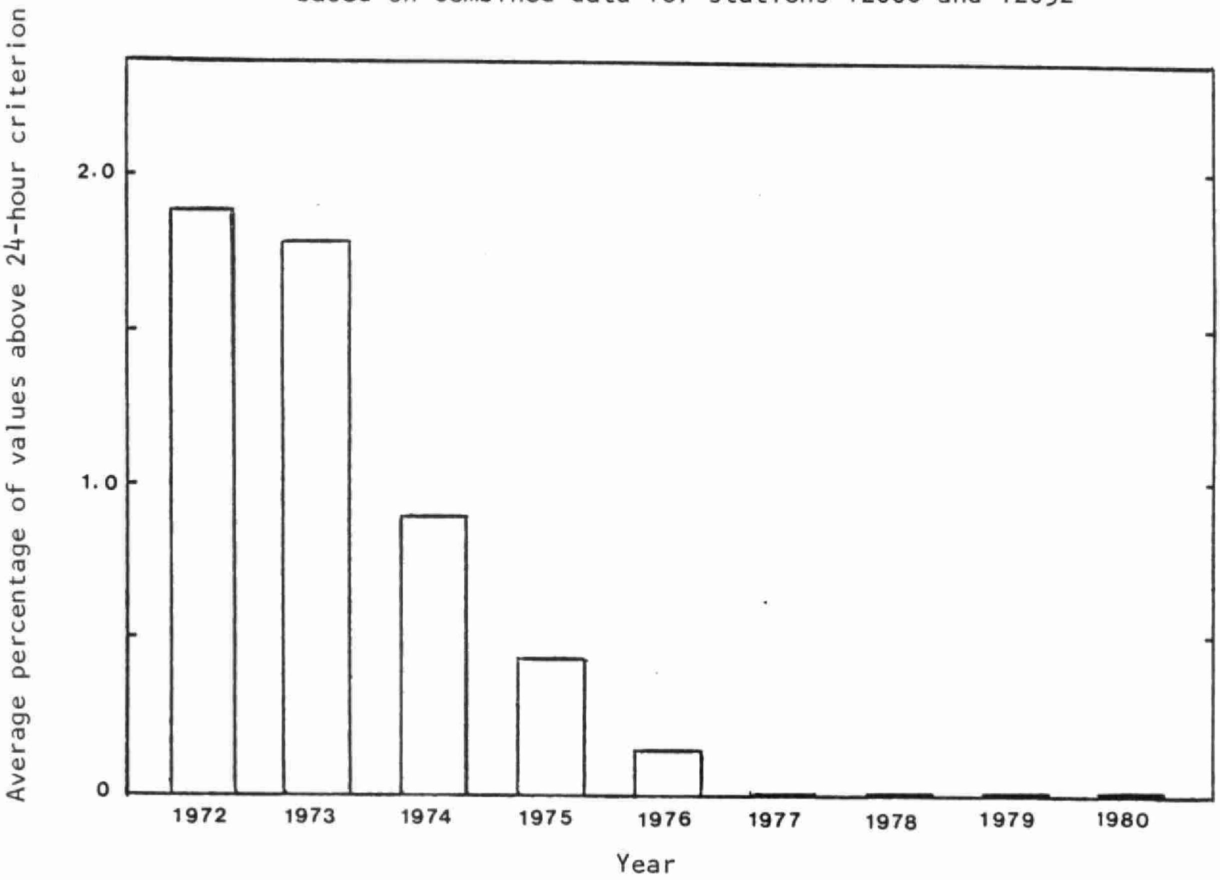
APPENDIX 3

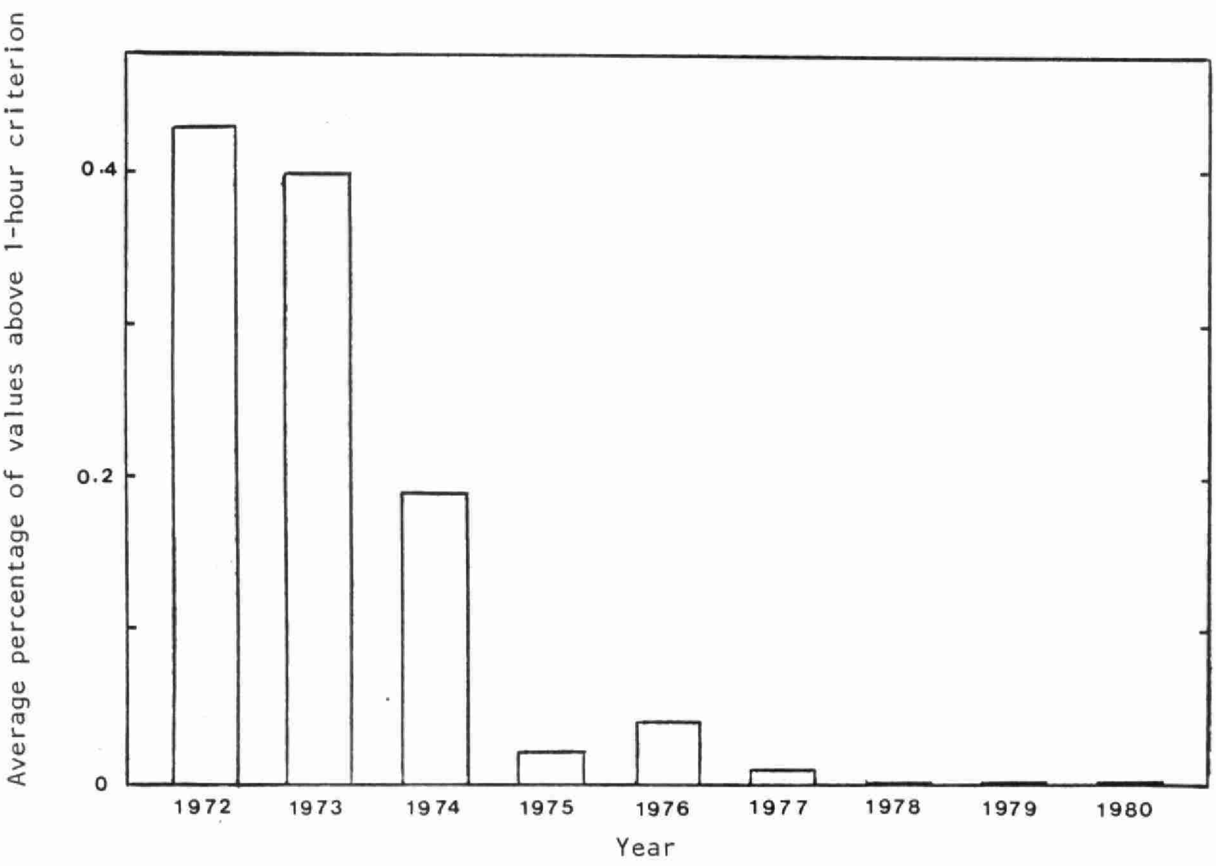
SULPHUR OXIDES

Table 7. Summary of 1980 data for sulphur dioxide

Parameter	Station number 12008	12013	12016	12032
Annual average (ppm)	0.01	0.00	0.01	0.01
Percentage of values greater than:				
1-hour criterion	0	0	0	0
24-hour criterion	0	0	0	0
Highest 1-hr value (ppm)	0.13	0.09	0.13	0.24
Highest 24-hr value (ppm)	0.04	0.02	0.04	0.08

Figure 6. Trend in frequencies of excursions for sulphur dioxide based on combined data for stations 12008 and 12032





APPENDIX 4

CARBON MONOXIDE, OXIDES OF NITROGEN TOTAL HYDROCARBONS AND OZONE

Table 8. Summary of data for carbon monoxide, oxides of nitrogen, hydrocarbons and ozone.

Parameter	1980	1979	1978	1977	1976	1975	1974	1973	1972
Carbon monoxide									
Annual average (ppm)	2	2	2	2	4	5	5	5	5
Percentage of values greater than:									
1-hour criterion	0	0	0	0	0	0	0	0.01	0
8-hour criterion	0	0	0	0	0	0.32	0.30	0.10	0
Nitrogen dioxide									
Annual average (ppm)	0.03	0.03	0.04	0.03	0.03	0.03	0.03		
Percentage of values greater than:									
1-hour criterion	0	0	0.01	0	0	0	0		
24-hour criterion	0	0	0	0	0	0	0		
Nitric oxide									
Annual average (ppm)	0.02	0.02	0.03	0.03	0.03	0.03	0.04		
Total oxides of nitrogen									
Annual average (ppm)	0.05	0.05	0.07	0.07	0.06	0.06	0.07		
Total hydrocarbons									
Annual average (ppm)	2.2	1.9[a]	2.3	2.4	2.6	2.2	1.9	2.1	2.2
Ozone									
Annual average (ppm)	0.020	0.016	0.018	0.021	0.021	0.017	0.014		
Percentage of values greater than 1-hour criterion	1.8	0.8	2.4	3.1	2.5	2.2	0.8		

(a) 9 months of data

APPENDIX 5

FLUORIDES

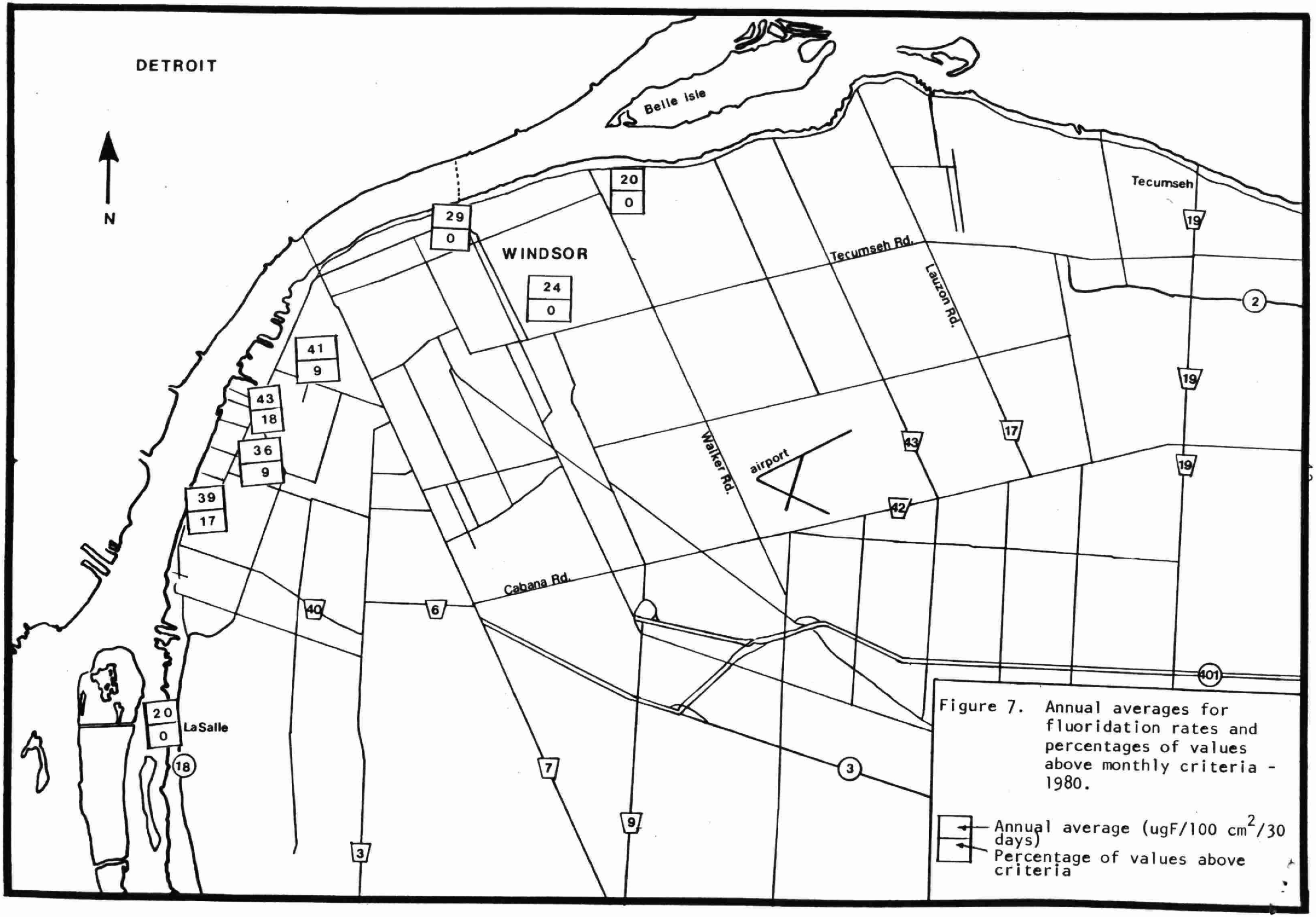


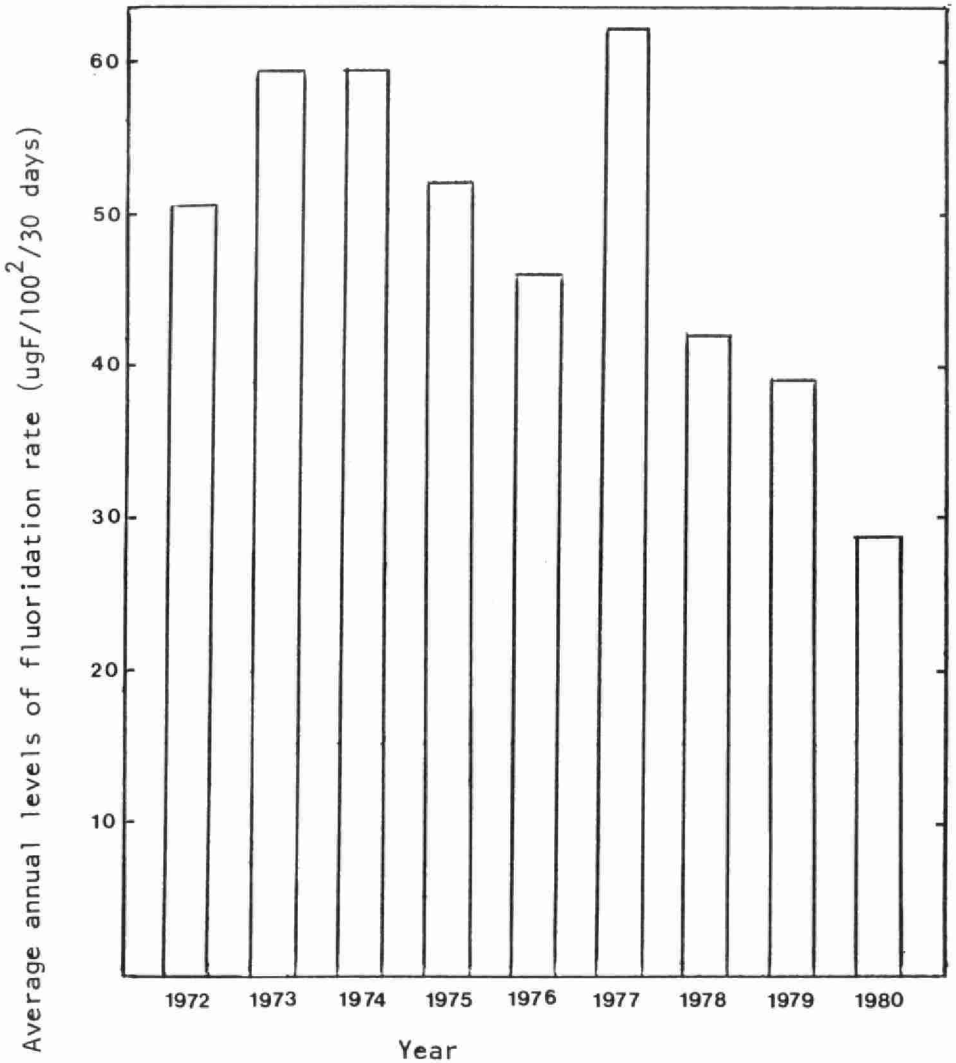
Figure 7. Annual averages for fluoridation rates and percentages of values above monthly criteria - 1980.

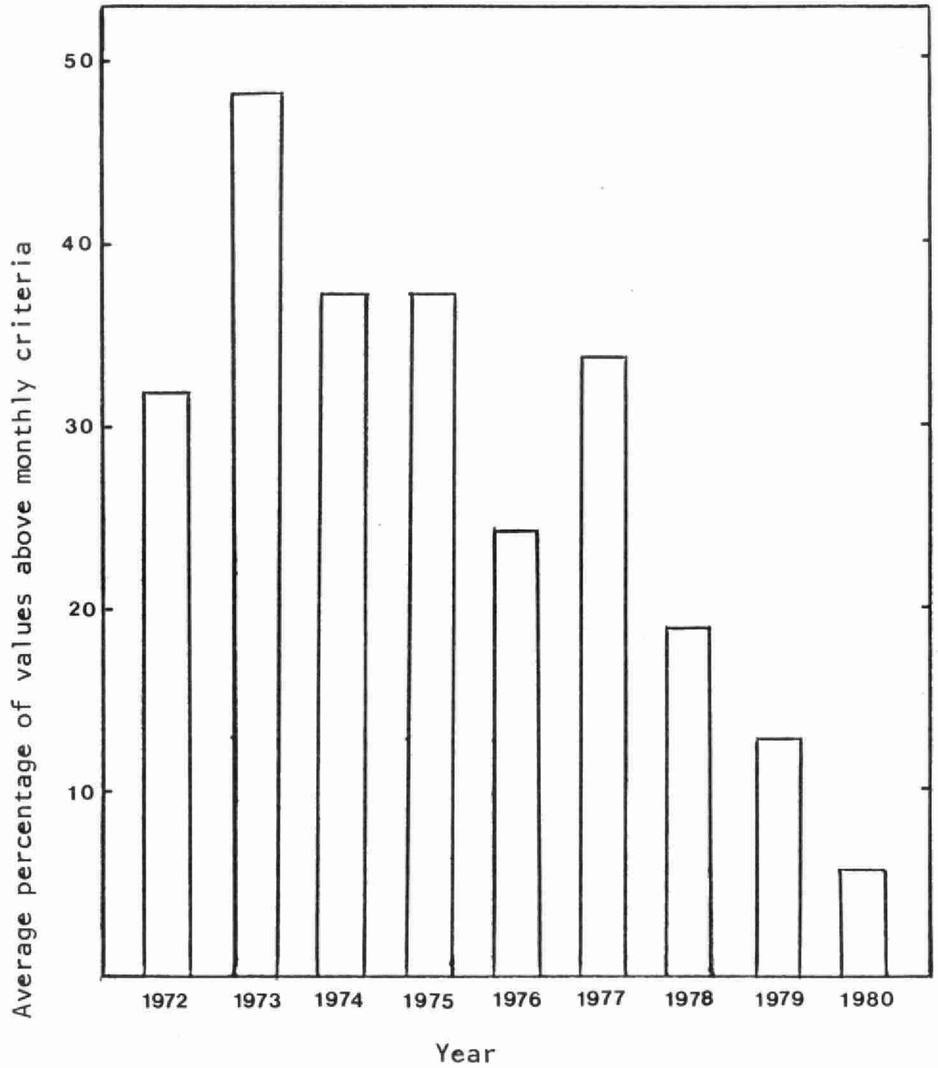
Table 9. Levels of fluoridation rate during 1980

Station Number	Fluoridation rate (ugF/100 cm²/30 days) Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec	Annual Average	Percentage of values above criteria
12008	28	13	31	30	28	24	40	36		19	35	33	29	0
12015	30	32	76	43	$\underline{42}$	38	$\underline{47}$	38		36	53	42	43	18
12016	37	36	40	34	40	28	$\underline{66}$	31		36	49	51	41	9
12022	19	17	16	18	19	18	29	25		14	23	18	20	0
12027	18	16	78	12	24	19	34	17		12	20	19	24	0
12032	--	--	--	--	--	33	$\underline{41}$	11		45	57	48	39	17
12040	18	16	19	21	16	18	26	24		19	22	18	20	0
12045	36	20	36	44	30	25	$\underline{57}$	24		34	41	47	36	9

Note: Underlined values exceed criteria for desirable ambient air quality.

Figure 8. Trend in levels of flurodiation rates based on averaged data for six monitoring stations





DATE	ISSUED TO